SOCIAL SECURITY AND RETIREES' DECISION TO WORK

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Abstract

The current paper addresses whether beneficiaries will respond to ongoing Social Security benefit reductions by increasing post-retirement labor supply. Non-linearities in the benefits formula allow one to estimate the effect of benefit size on retirees' probability of working while simultaneously controlling for inputs into the benefits formula. Consistent with economic theory, larger benefits significantly decrease the probability of work among married retirees. A 10% increase in benefit size decreases the probability of work 3-4 percentage points for recently retired husbands (from a mean of 25.5%) and 2-3 percentage points for recently retired wives (from a mean of 12.8%). For both spouses, the effect disappears in the later years of retirement, suggesting earnings are unlikely to offset benefit reductions for older retirees.

I. Introduction

The 1983 Amendments to the Social Security Act mandated a gradual increase in the normal retirement age from 65 to 67. Since penalties are imposed for early retirement, the vast majority of Social Security (SS) beneficiaries will consequently suffer a substantial reduction in benefits.[1] Holding real earnings histories constant, workers born in 1960 and retiring at age 62 (the minimum age for claiming benefits) will have benefits reduced 12.5% relative to similar workers born in 1937. For workers retiring at age 65, benefits will decline 13.3%. Heavy reliance on Social Security implies that benefit reductions could increase financial hardship among the elderly unless they respond by (1) delaying retirement, (2) increasing pre-retirement savings or (3) increasing earnings post-retirement. Considerable research exists on the first two of these issues, with mixed results.[2] The purpose of this paper is to provide some much needed evidence on the third.

Estimating the effect of SS benefit size on post-retirement labor supply is complicated by the fact that benefit size is a function of a worker's earnings history and retirement age, both likely correlated with unobserved determinants of post-retirement work. The identification strategy adopted in this paper uses the fact that benefit size is a known function of precisely measured inputs. Presumably, any correlation between benefit size and the unobserved determinants of work is driven entirely by correlation between benefit formula inputs and the unobservables. Non-linearities in the benefits formula allow one to estimate the effect of benefit size while simultaneously controlling for inputs into the benefits formula, producing unbiased estimates of the effect of benefit size on the

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1 Throughout this paper, the term "retirement" is treated as synonymous with initial claiming of Social Security benefits.

2 The most compelling evidence that SS affects retirement behavior is the otherwise unexplainable spike in the retirement hazard at age 62, but does not speak to the impact of benefit size. Estimates of a negative effect of benefit size on the labor force participation of elderly men suffer from potential correlation between the determinants of SS benefit size and retirement behavior. Krueger and Pischke (1992) find the dramatic decline in the labor force participation of elderly men continued unabated despite an unexpected reduction in benefits. In their summary of the literature, Diamond and Gruber (1997) conclude "there is only mixed evidence that changes in the overall generosity of the system has much effect on retirement behavior." Feldstein (1974, 1996) estimated a substantial negative impact of SS wealth on personal savings, though his findings remain controversial. Taken together, the literature broadly suggests SS benefit size reduces pre-retirement savings, though the magnitude remains unclear (Hurd 1990).

decision to work. Since a key non-linearity applies specifically to married retirees, the analysis focuses on married retirees whose spouse is also retired. The empirical strategy allows for straightforward specification tests that demonstrate benefit size is uncorrelated with observed determinants of work after controlling for formula inputs.

Consistent with the standard model of labor supply, I find SS benefit size has a statistically significant though modest effect on the probability of work by married retirees. A 10% increase in SS benefit size decreased the probability a retired husband was currently working by 3-4 percentage points (from a mean of 25.5%) and decreased the probability a retired wife was currently working by 2-3 percentage points (from a mean of 12.8%). The work effect appears to be driven by changes in part-time rather than full-time work, perhaps due to disincentives for full-time work created under the SS earnings test. For both spouses, the work effect appears to erode in the later years of retirement. Additional analyses considered the effect of benefit size on various sources on income. While too imprecise to draw strong conclusions, these results suggest that higher benefits are offset by reductions in husbands' earnings and pension income. Nonetheless, benefit size was found to have a substantial and significant impact on the log total income of jointly retired couples.

The remainder of this paper is structured as follows. Section II describes the SS benefits formula as it applies to the sample being studied. Section III describes the main econometric specification used in the study and explains how non-linearities in the benefits formula allow identification of the benefit size effect on retirees' work. Section IV describes the data used in this study. Section V presents the empirical results, including specification tests that support the plausibility of the identification strategy. Concluding remarks are offered in Section VI.

II. OASI Benefit Formula

The current study focuses on beneficiaries of Old Age and Survivors Insurance (OASI), the component of Social Security that pays benefits to eligible retired workers, their dependents and their survivors. Almost 39 million individuals received about $353 billion in OASI benefits in 2000.[3] The following sections describe how OASI benefits are calculated, focusing on details that relate to recipients born between 1910 and 1919 who receive SS either as a retired worker or the spouse of a retired worker, the beneficiaries relevant for this study.

A. Retired Worker Benefits

Workers who are age 62 or older with at least 10 years of covered earnings since 1951 are eligible for the standard worker retirement benefit under OASI. "Covered earnings" refer to earned income subject to the Social Security payroll tax. Earnings that exceed the covered earnings maximum in a given year are not subject to payroll taxes, but are also not used in calculating the OASI benefit. The covered earnings maximum has historically varied from year to year (in both real and nominal terms). Over the years 1951-1981, this maximum has been set as low as 103% of average nominal earnings (in 1965) and as high as 216% of average nominal earnings (in 1981).[4]

When benefits are initiated, the Social Security Administration calculates the *primary insurance amount* (PIA) of the worker as a function of her covered earnings history. The PIA determination formula changed substantially over the birth cohorts in this study as will be discussed below. In general, the PIA is calculated as a concave function of the worker's average covered earnings taken over the worker's highest earnings years.

The PIA is the size of the *monthly benefit amount* (MBA) a worker is entitled to if benefits are initiated at normal retirement age. Workers retiring before the normal retirement age are penalized through an actuarial reduction in their MBA. Historically, benefits have been permanently reduced by

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3 Social Security Bulletin *Annual Statistical Supplement* (2001).
4 See Appendix Table A1.

5/9 of 1% per month for each month that benefits are received prior to the normal retirement age. Under the 1983 amendments, this "actuarial reduction factor" (ARF) continues to apply for the first 36 months of early benefit receipt, but a lower ARF of 5/12 of 1% is applied for each month in excess of 36. Thus, the maximum actuarial reduction is 20% when the normal retirement age is 65, but gradually increases to 30% as the normal retirement age increases to 67.

Workers initiating benefits after normal retirement age are rewarded through the "delayed retirement credit" (DRC), first implemented in 1972 and increased under both the 1977 and 1983 amendments. Initially, benefits were increased by 1/12 of 1% for each month benefits were delayed past normal retirement age up to a maximum retirement age of 72. The DRC was increased to 1/4 of 1% for the 1917-1924 birth cohorts. Under the 1983 amendments, the DRC is gradually being increased for later cohorts to 2/3 of 1%, however credits only accumulate up to age 70. Thus, while early retirees suffer large benefit reductions under the 1983 amendments, future beneficiaries who delay retirement beyond age 68.25 will receive larger benefits than they would have in the past.

The relationship between a worker's MBA, PIA and retirement age can be depicted mathematically as follows:

$$
\begin{aligned}
MBA_{i1} &= m_1(RA_i) * PIA_i \\
&= m_1(RA_i) * f(CE_i, YOB_i)
\end{aligned}
$$

where MBA_{i1} ~ MBA of beneficiary *i* receiving worker retirement benefits

RA_i ~ retirement age of beneficiary *i*

$m_1(.)$ ~ PIA multiplier for calculating retired worker MBA[5]

CE_i ~ covered earnings history of beneficiary *i*

YOB_i ~ birth year of beneficiary *i*

$f(.)$ ~ PIA determination function

5 The term "PIA multiplier" encompasses both the ARF and the DRC.

B. Spousal Benefits

Spouses of eligible workers are entitled to receive OASI benefits based on the PIA of their spouse. As with retired worker benefits, spouses can begin collecting spousal benefits as early as age 62, and benefits are reduced for early retirement. Spousal benefits are not increased for delaying first receipt.

Spouses who initiate benefits at normal retirement age are entitled to an MBA equal to 50% of their spouse's PIA. Historically, spousal benefits were permanently reduced by 25/36 of 1% for each month that benefits are received prior to normal retirement age. Under the 1983 amendments, the same reduction factor continues to apply for the first 36 months of early benefit receipt, but a lower reduction factor of 5/12 of 1% is applied to each month in excess of 36. Thus, spouses retiring at age 62 received 37.5% of their spouse's PIA when the normal retirement age was 65, but will receive 32.5% of their spouse's PIA when the normal retirement age reaches 67, a reduction of 13.3%. The determination of spousal MBA can be depicted as follows:

$$\begin{aligned} MBA_{i2} &= m_2(RA_i) * PIA_s \\ &= m_2(RA_i) * f(CE_s, YOB_s) \end{aligned}$$

where MBA_{i2} ~ MBA of retired beneficiary *i* receiving spousal benefits

RA_i ~ retirement age of beneficiary *i*

$m_2(.)$ ~ PIA multiplier for calculating spousal MBA

CE_s ~ covered earnings history of beneficiary *i*'s spouse

YOB_s ~ birth year of beneficiary *i*'s spouse

$f(.)$ ~ PIA determination function

C. Worker/Spousal Benefit Interaction and Total Household MBA

It is relatively common for both spouses in a household to be eligible for the retired worker benefit. In this case, each spouse is eligible to receive the larger of the retired worker benefit (MBA_{i1}) or the spousal benefit (MBA_{i2}):

$$\begin{aligned} MBA_i &= \text{Max}\,[MBA_{i1}, MBA_{i2}] \\ &= \text{Max}\,[m_1(RA_i) * PIA_i\ ,\ m_2(RA_i) * PIA_s] \end{aligned}$$

As a result, the total MBA of a jointly-retired couple is a disjoint function of the PIAs and retirement ages of each husband (*h*) and wife (*w*):

$$MBA_{tot} = \begin{cases} [m_1(RA_h) + m_2(RA_w)] * PIA_h \\ \qquad \text{if} \quad PIA_w < PIA_h * m_2(RA_w)/m_1(RA_w) \\ \\ m_1(RA_h) * PIA_h + m_1(RA_w) * PIA_w \\ \qquad \text{if} \quad PIA_w \in [PIA_h * m_2(RA_w)/m_1(RA_w),\ PIA_h * m_1(RA_h)/m_2(RA_h)] \\ \\ [m_2(RA_h) + m_1(RA_w)] * PIA_w \\ \qquad \text{if} \quad PIA_w > PIA_h * m_1(RA_h)/m_2(RA_h) \end{cases}$$

Or, written in logs:

$$\ln MBA_{tot} = \begin{cases} \ln[m_1(RA_h)) + m_2(RA_w)] + \ln(PIA_h) \\ \qquad \text{if} \quad PIA_w < PIA_h * m_2(RA_w)/m_1(RA_w) \\ \\ \ln[m_1(RA_h)] + \ln(PIA_h) + \ln[1+(m_1(RA_w)*PIA_w)/(m_1(RA_h)*PIA_h)] \\ \qquad \text{if} \quad PIA_w \in [PIA_h * m_2(RA_w)/m_1(RA_w),\ PIA_h * m_1(RA_h)/m_2(RA_h)] \\ \\ \ln[m_2(RA_h) + m_1(RA_w)] + \ln(PIA_w) \\ \qquad \text{if} \quad PIA_w > PIA_h * m_1(RA_h)/m_2(RA_h) \end{cases}$$

The log representation depicts a key feature of the social security benefit calculation. For couples where the husband has substantially higher covered earnings than the wife, total MBA rises proportionally with increases in the husband's PIA but is unaffected by changes in the wife's PIA. If the wife has substantially larger covered earnings, the opposite is true. When spouses have relatively equal covered earnings, total MBA rises less than proportionally with increases in both husband's and wife's PIA. This relationship is depicted in Figure 3.

D. PIA Determination Formula

Over the birth cohorts analyzed in this study, the formula for calculating a retired worker's PIA underwent a major change that created the well known "benefits notch."[6] For workers born 1910-1916, the highest N years of nominal covered earnings (since 1951) are used to calculate the worker's *average monthly wage* (AMW). N is set equal to the worker's year-of-birth plus six except for male workers born 1910-1912, for whom N equals 19. The worker's PIA is then calculated as a function of the worker's AMW. Though basically increasing and concave in the AMW, the PIA function is actually piecewise linear with numerous "kink" points (14 in 1982). The formula also establishes a set minimum PIA for all eligible workers in these birth cohorts ($183 in 1982). PIAs are increased annually to offset cost-of-living increases.

Workers born after 1916 are subject to a new PIA formula implemented to reduce the size of benefits. To ease transition to the new formula, workers born 1917-1921 (the "notch" cohorts) receive the higher of two possible PIAs: one calculated under the new formula and one calculated under a specially designed transition formula. Under the transition formula, the AMW is calculated the same way as under the previous formula except that covered earnings after the year age 61 is attained are excluded. The same function is applied to calculate the PIA from the transition AMW, however no

6 A description of this change and its subsequent impact on benefits can be found in the *Final Report on the Social Security "Notch" Issue* (available online, see reference). See Krueger and Pischke (1992) and Evans and Snyder (2001) for interesting empirical studies using the benefits notch as a source of exogenous variation in benefit size.

cost-of-living adjustments are applied before the year the worker turns age 62. Under the new formula, covered earnings in the years before the worker turns age 60 are indexed to the average nominal wage in the year she turns 60. Covered earnings in succeeding years are left in nominal amounts. The highest *N* years of indexed covered earnings are used to calculate the worker's *average indexed monthly earnings* (AIME). Again, a somewhat concave function is employed to determine the PIA under the new formula. The piecewise linear formula contains three distinct "kink" points. Minimum PIAs are established for low earning eligible workers, though these minimums vary by birth year.[7]

III. Econometric Specification

A. Social Security and Retirees' Decision to Work

Under the standard model of labor supply, workers choose their optimal labor supply (hours of work) at the point where the marginal utility of additional earned income equals the marginal disutility of additional work. In the extreme, workers find it optimal not to work when the marginal disutility of a single hour of work exceeds the marginal utility of an hour's worth of earned income (determined by their wage). Since unearned income decreases the marginal utility of earned income, larger Social Security benefits are expected to reduce the probability a retiree will choose to work. This relationship can be estimated as:

$$\begin{aligned} \Pr\,[i \text{ works}] &= \Pr\,[\alpha\ - f\ \ln(SS_i) < e_i\ ] \\ &= ?\ \ [\alpha\ - f\ \ln(SS_i)] \end{aligned}$$

where e_i is a composite variable capturing unobserved variation in hourly wage and the preference for leisure relative to income, and ? (.) is the cumulative distribution function of e.

7 The 1982 minimum PIAs are \$183 for the 1917 birth cohort, \$167 for the 1918 birth cohort and \$131 for the 1919 birth cohort.

Assuming e is uncorrelated with SS benefit size and ? (.) follows a logit distribution, estimation of a single-variable logit (probability of work on log SS benefit size) will produce an unbiased estimate of the effect of SS on the probability of work. However, the exogeneity assumption is highly problematic given the way SS benefits are calculated. Household benefit size is a non-decreasing function of each spouse's prior earnings and retirement age, each likely correlated with unobserved determinants of post-retirement work (e). Higher prior earnings generally reflect higher wages and/or higher labor force attachment during one's pre-retirement years, and are therefore expected to be associated with higher current wage and lower disutility of work. Individuals with higher wages are less likely to retire early, further contributing to the positive relationship between current wage and benefit size. Studies also suggest that high discount rates,[8] poor health[9] and low life expectancy[10] contribute to earlier retirement. Each of these factors is likely correlated with unobserved determinants work and bias estimates of f in the *negative* direction.

Logit estimates are also likely confounded by the existence of other unearned sources or retirement income, such as pension and asset income. Since these sources of unearned income are positively correlated with pre-retirement labor and wages, they are therefore positively correlated with the SS benefit size.[11] Higher pension and asset income is expected to reduce labor supply for the same reason a larger SS benefit does. As a result, the positive correlation between unearned, non-SS income and SS benefit size tends to bias estimates of f in the *positive* direction.

8 See Gustman and Steinmeier (2002).
9 See Dwyer and Mitchell (1999) and Bound (1999).
10 See Hurd et al. (2002).
11 Life-cycle models of wealth accumulation would suggest that variation in retirement wealth can be explained by differences in time discount rates, risk tolerance and relative taste for work and leisure at alternative ages (as discussed by Bernheim et al. 2001), which could also generate variation in non-SS unearned income levels.

B. Identification Strategy

For the above reasons, estimating a single-variable logit is unlikely to produce an unbiased estimate of the effect of SS benefit size on the decision to work. While the direction of the bias is ambiguous, this provides little comfort. Our objective is an unbiased estimate of the effect of SS benefit size on work, not an ambiguously biased estimate. The standard approach for addressing such biases would be to move from the single-variate specification to a multi-variate specification, controlling for observed characteristics intended to capture variation in current wage, marginal disutility of work and marginal utility of income. This approach is problematic for a number of reasons. Standard proxies for current wage (e.g. socio-demographic variables, asset wealth, etc.) are unlikely to "break" the correlation between current wage and benefit size.[12] Reported health can potentially capture differences in disutility of work, but is potentially endogenous with the decision to work.[13] Unearned, non-SS income (e.g. pension and asset income) could proxy for marginal utility of income, but is also endogenous with work.[14] As a result, standard covariates (X) are unlikely to satisfy the exogeneity condition, Cov(SS, e | X) = 0, and could simply introduce new sources of bias.

The approach taken in this paper focuses on the inputs of the benefit formula rather than the confounding unobservable determinants of post-retirement work. While the exact relationship between benefit size and the unobservable determinants of work is unknown, it is reasonable to assume that any correlation exists solely because the *formula inputs* are correlated with the unobservables. Non-linearities in the OASI benefits formula allow us to estimate the effect of benefit size on work in a multi-variate logit that includes flexible controls for the formula inputs (Z). Inclusion of these covariates reasonably justifies the exogeneity assumption, Cov(SS, e | Z) = 0, but

12 Wage of job prior to retirement would be helpful but is not consistently measured in the NBS.
13 Several researchers have argued that individuals commonly misrepresent their health status as justification for leaving the labor force. Evidence supporting the "justification hypothesis" can be found in Bound (1991), Anderson and Burkhauser (1985), Bazzoli (1985), and Chirikos and Nestel (1984). Evans and Snyder (2002) demonstrate that work affects the mortality of elderly men, suggesting simultaneous effects between health and work.
14 Mitchell (1991) documents that pension plans are commonly integrated Social Security, leading to lower pension incomes when SS benefit size increases.

naturally introduces a large degree of collinearity in the model, decreasing the precision in the estimated effect of benefit size.

This approach is analogous to the one described by Barnow et al. (1981) and discussed in Angrist and Krueger (1999). To quote Barnow et al., "Unbiasedness is attained when the variables that determined the assignment are known, quantified and included in the equation" (p47). While the variable of interest in Barnow et al. is a dichotomous treatment variable, in our setting "assignment" can be interpreted as the determination of benefit size. The roots of this approach can also be traced to the regression-discontinuity design first introduced by Thistlethwaite and Campbell (1960) and discussed in detail in recent papers by Hahn et al. (2001) and Van der Klaaw (2002).

While the assumption that benefit size is uncorrelated with unobservable determinants of work conditional on the formula inputs is plausible, it is far from certain. For instance, couples that understand how their individual earnings interact to affect their total benefit amount might alter their joint pre-retirement labor supply in response, though this seems unlikely given the complexity of the formula. More plausible is the possibility that individuals who are considering retirement might adjust that decision (e.g. decide to keep working) once they find out the size of the benefit they are entitled to. If true, this would introduce endogeneity between benefit size and retirement age, and possibly earnings in the years directly preceding retirement.

Evidence on the effect of benefit size on retirement age has been mixed,[15] but Krueger and Pischke (1992) provide convincing evidence that the *unexpected* decrease in SS benefits caused by the benefit notch had little effect on retirement age. Since our model conditions on inputs into the benefits formula, identification of the SS effect comes from deviations in benefit size from what would be predicted by the input variables. As a result, variation in the "unexplained" part of benefit size is more likely to resemble an unexpected change in benefit size than an expected change, suggesting the evidence from Krueger and Pischke is applicable to our situation.

15 Diamond and Gruber (1997) provide a summary of these studies.

Nevertheless, endogeneity and omitted variable bias remain potential problems. Straightforward specification tests allow us to detect the presence of such biases. These specification tests are based on a simple premise: if benefit size were correlated with the *unobserved* determinants of work (conditional on the formula inputs), we would expect benefit size to be correlated with the *observed* determinants as well. We will see that this is not the case.

C. Social Security Earnings Test and Implications for the Decision to Work

Under the SS earnings test, benefits are reduced by $1 for every $2 of earned income above the *allowable earnings amount* (AEA).[16] As a result, the marginal effect of earned income on the consumable income of SS beneficiaries varies depending on the level of earnings. Earnings under the AEA increase consumable income dollar per dollar (net of income taxes). Once earnings exceed the AEA, SS income is offset by $1 for every two additional dollars of earned income. Social security income is completely offset when earnings exceed the AEA plus twice the retirees' SS benefit. Thus, the earnings test produces two distinct "kink points" in the budget constraint of SS beneficiaries as depicted in Figure 4.

As earnings approach the AEA, strong disincentives to increase labor hours exist due to the high implicit tax rate. Assuming earnings are taxed at a 20% rate, an additional dollar of earnings just above the AEA nets a mere 30 cents in additional consumable income. A number of studies have documented a discernible degree of "bunching" in the distribution of retirees' earned income just below the AEA level, suggesting that some retirees respond to the earnings test by limiting their earnings below the AEA as we would expect.[17] For retirees who would earn above the AEA without the earnings test, the effect of the earnings test is theoretically ambiguous. The high implicit tax rate would tend to reduce labor hours since the financial return to work is reduced (substitution effect),

16 The AEA has historically varied depending on age of the retiree. In 1982, the AEA was set at $4400 for retirees under age 65 and $6000 for retirees age 65 and older. The AEA was eliminated for retirees over age 70 in 1983, and was eliminated for those above the normal retirement age in 2000. The earnings offset was changed from 1-to-2 to 1-to-3 for retirees aged 65-69 in 1990.
17 E.g. Burtless and Moffitt (1985) and Friedberg (1999).

while the income lost as result of the earnings offset tends to increase the marginal utility of income, inducing increased labor supply (income effect). In fact, Gruber and Orszag (2000) fail to find a substantial impact of the earnings test on aggregate labor supply.

Regardless, the earnings test is not expected affect retirees' decision to work since the SS offsets do not apply to initial earnings. This implication is presented clearly in Figure 5, which depicts the budget constraint for a retiree with benefit size SS_1, and another budget constraint supposing an exogenous increase in benefit size to SS_2. Three indifference curves are presented depicting possible labor supply decisions under the original (SS_1) budget constraint. In each case, the income effect suggests that retirees will reduce work hours in response to a marginal increase in benefit size. Retirees with earnings in the lowest range (below the AEA) might respond to a marginal increase in benefit size by exiting the labor market altogether (the outcome of interest), but this same implication does not apply to retirees whose earnings exceed the AEA. Thus, the marginal effect of benefit size on the decision to work is expected to operate solely on the lowest would-be earners.

Rigidities in the labor market could confound this implication. Studies on prime-age workers have found that choice of work hours is frequently constrained by fixed employment costs, minimum hours requirement and tied wage-hours contracts.[18] Suppose, for instance, the retiree in Figure 6 is constrained to two employment options: no employment or a full-time job requiring H_F hours. In such a scenario, a retiree might choose to exit the labor market in response to a marginal increase in benefit size. Indeed, the preferences represented by the depicted indifference curves in Figure 6 suggest such an outcome. As a result, estimates of the marginal effect of benefit size on the decision to work could potentially reflect both an income effect and a substitution effect since higher benefits decrease the financial return from taking a high-paying, fixed-hours job.

This is unlikely for two reasons. First, the confounding substitution effect only exists if retirees' choice of hours is constrained. The responsiveness of retirees to the earnings test (the

18 For example, Card (1990), Altonji and Paxson (1988, 1992), Cogan (1981), and Hausman (1980). Hurd (1996) looks specifically at the effect of labor market rigidities on the labor supply of older workers.

"bunching" result) suggests a substantial degree of hours flexibility for the types of jobs taken by retirees. Second, even if hours are constrained, the confounding substitution effect only presents itself over a small range of the budget constraint, specifically, the range immediately following the point where benefits are completely offset by the earnings test. For the effect of benefit size on the decision to work to be driven by the interaction between benefit size and the earnings test, retirees would have to be commonly constrained to employment contracts that pay them *just enough* to fully offset their benefit.

IV. Data Description

The New Beneficiary Survey (NBS) was conducted in late 1982 through early 1983 to provide a snapshot of new SS beneficiaries. Respondents consisted of a stratified, nationally representative sample of beneficiaries selected from the Social Security Administration's Master Beneficiary Records who had started receiving SS benefits during the 12-month period beginning July of 1980. Personal interviews were conducted with 9103 recipients of retired worker benefits, 2417 recipients of spousal benefits and 5172 recipients of disability insurance (DI). The NBS interviews covered a wide range of topics including demographic characteristics, marital and childbearing history, current employment, employment history, current income and assets, and health. Less comprehensive data was gathered from the spouses of currently married recipients. The response rate for the NBS was 87.5%. Selective data from Social Security, Supplemental Social Security (SSI) and Medicare administrative records are also available for NBS respondents and their spouses. For our purposes, this is a key feature of the NBS, allowing us to observe inputs into the SS benefits formula that are not commonly available.[19]

Respondents were selected conforming to the identification strategy outlined above. Table 2 presents a summary of the selection criteria and the effect of each on sample size. Since the model is largely identified off the interaction between the benefit inputs of spouses, the sample is restricted to

19 The Health and Retirement Survey (HRS) has also been merged with SSA records, but use of the merged HRS-SSA dataset is restricted. Application for access to this data is underway.

married respondents with a completed spousal questionnaire. The analysis focuses on couples that are jointly retired by 1982; therefore couples were dropped if either spouse was born after 1919 (latest cohort that could retire in 1981). Couples were also dropped if the husband was born before 1910 and/or the wife was born before 1912. Different year cutoffs were applied for husbands and wives to ensure a reasonable number of each in represented birth-year cohorts. Couples were dropped if they received any form of public assistance other than OASI benefits for retired workers and their spouses since receipt of such assistance could confound the SS income effect.[20] Earnings of federal employees and military personnel are generally not covered under SS; therefore couples were dropped if either spouse received a federal/military pension or a veteran's benefit. Couples with children under 18 were dropped since children under 18 are eligible to receive OASI benefits as the dependent of a retired worker. Finally, 293 couples were dropped due to substantial discrepancies between a worker's recorded PIA and that predicted by the benefit formula. The resulting dataset consists of 3196 married respondents and their spouses. For 2811 couples in this sample (88.0%), the respondent's spouse had also started receiving benefits by the end of 1981.

Applying the PIA formulas to the workers' covered earnings records generally produced excellent predictions of workers' PIAs. Most discrepancies appeared to be caused by unexplainable variations in whether or not the latest years of covered earnings were included in the benefits calculation. In fact, I found that calculating the predicted PIA in 1982 based on covered earnings through 1980 conformed closer to the recorded PIAs in 1982 than did calculations based on covered earnings through 1981. Couples that included an eligible worker with a recorded PIA that differed from the PIA predicted by the benefits formula by more than 10% were dropped from the sample (the 293 couples mentioned above).

PIAs calculated under the benefits formula (based on covered earnings through 1980) were then used to calculate the predicted total MBA for couples in 1982. Figure 7 graphs the

20 E.g. Supplemental Social Security (SSI) benefits are commonly received by retirees with low OASI benefit levels.

log of total predicted MBA (*lnMBAf*) against the log of total recorded MBA (*lnMBA*) in our sample. For comparison, couples that were excluded due to PIA discrepancies are also depicted. As the reader can see, the predicted *lnMBAf* and recorded *lnMBA* match quite well for those included in our sample, with a correlation coefficient exceeding 0.995. The mean difference between *lnMBAf* and *lnMBA* is 0.00013 with a standard error of 0.00053, and the mean absolute difference is 0.0184. That is, the predicted *MBAf* varies from the recorded *MBA* in 1982 by less than 2% on average. Where substantial deviations exist, they appear to result from eligible workers receiving a retired worker benefit despite their eligibility for a higher spousal benefit.

Table 3 provides summary statistics pertaining to socio-demographic and job history characteristics, asset wealth and retirement ages. Table 4 provides summary statistics regarding SS benefits, earnings and other sources of income. As expected, household SS income is somewhat lower when the respondent's spouse has not started benefits by 1982, and the earnings of unretired spouses are substantially higher. Worth note is the modest difference between monthly SS income and the amount of entitlement indicated by the MBA, presumed to result from earnings test offsets or intentional suspension of benefits.[21] As a result, mean MBA ($942) is 52.4% as large as mean total household income ($1798) in the both-retired sample, while mean SS income ($858) is only 47.7% as large. Finally, the table indicates that it is relatively common to for SS beneficiaries to engage in some amount of work activity, especially when one's spouse has yet to retire. Retired wives with a jointly retired husband are reported as currently working almost 13% of the time, rising to over 29% for retired wives with an unretired husband. Retired husbands with a jointly retired wife are currently working over 25% of the time, rising to over 43% for retired husbands with an unretired wife.

As discussed in Section III, the causal effect of SS benefit size on retirees' decision to work will be estimated in a multi-variate logit specification that includes flexible covariates for inputs into the benefit formula. Following earlier notation, I refer to the vector of formula input covariates as *Z* to distinguish it from the vector of socio-demographic covariates (*X*) included in some specifications.

21 By suspending benefits, a retiree can reduce the actuarial reduction for early retirement.

The vector *Z* includes variables capturing the retirement age, the AMW, and (for those born after 1916) the AIME of each husband and wife in our sample. Separate retirement age covariates were created for those who retired before and after age 65 due to the large spikes in retirement at these two ages. AMW∗birth-year interaction variables were created for each birth-year cohort. For those born after 1916, the transition AMW is used to create these variables. AIME∗birth-year interaction variables are included for those born after 1916 since their PIA is potentially calculated under the new formula. Third-order terms for each of these variables were included for each spouse in the vector *Z*. Also included were third-order terms for age of each spouse and age difference, as well as dummy variables for the birth-year of each spouse.

Since our model is largely identified by the unique interaction of PIAs in determining the total household MBA, additional covariates were added to *Z* to capture the *relative* covered earnings of each husband-wife pair. Using the covered earnings of each spouse from the year they turned 41 (earliest age for which covered earnings are available for 1910 cohort) through the year they turned 61, three measures were constructed:

- number of years CE > 0
- number of years CE > ½ mean nominal earnings in year
- number of years CE > mean nominal earnings in year

For each measure, third-order covariates were created for the husband's measure, the wife's measure and the difference. Though limited, these measures could be consistently constructed across individuals with different birth years and retirement ages.[22] In all, the vector *Z* consists of 130 covariates.

22 Measures like mean (indexed or nominal) CE could not be consistently constructed across birth cohorts because of variation in the maximum CE across years.

An additional vector of covariates (*X*) was created to capture characteristics of each couple that are unrelated to the benefit formula but are potentially correlated with the unobservable determinants of work. These covariates include the following:

- race/ethnicity (black race and hispanic/non-black indicators)
- time married (third-order)
- number of children (indicators for 1, 2 and 3 or more)
- years of education (third-order, with indicator for <5 years)
- "professional" occupational code in longest job (indicator)
- "self-employed" in longest job (indicator)
- presence of other adult in household (adult child and other adult indicators)
- ever contributed to pension (indicators for husband, wife and both)
- asset wealth (third-order, with indicators for zero and ≥$500,000)

In all, 37 covariates are included in the *X* vector. Assuming the identifying assumption holds, the estimated work effect should be unaffected by the inclusion of the *X* covariates. Indeed, estimation results with and without the *X* covariates were found to be quite similar.

V. Empirical Results

A. Predicted versus Recorded MBA

As noted earlier, the value of *lnMBAf* occasionally deviates from the *lnMBA* recorded in the dataset, and these deviations are potentially correlated with the unobserved determinants of work or affected by working.[23] The standard approach to this problem would be to use *lnMBAf* as an instrument for *lnMBA* in an instrumental variables model, but would require specifying the (second

23 Many of these deviations appeared to result from variation in the timing of benefit re-calculations that occur when workers continue to accumulate covered earnings in post-retirement or when adjustments are made to the PIA multiplier as result of benefits foregone because of the earnings test. As mentioned earlier, some recipients were receiving a worker's benefit when the benefit formula predicted a larger spousal benefit.

stage) probability of work in a linear probability model. Instead, I chose to maintain the non-linear (logit) specification for probability of work, estimating a reduced-form model with *lnMBAf* as our independent variable of interest.

Table 5 indicates that *lnMBAf* is a powerful predictor of *lnMBA*. Without covariates, the coefficient on *lnMBAf* is a precisely estimated 1.00 ($R^2 = .991$). Inclusion of the *Z* covariates decreases the estimate slightly to 0.96. A coefficient of 1 would suggest that reduced-form models produce unbiased estimates of the true effect of *lnMBA* on work. Our results suggest that the reduced-form estimates are biased towards zero, but only slightly. Table 6 repeats the *lnMBA* prediction model in the years following the survey period. As seen, *lnMBAf* remains a powerful predictor of *lnMBA* well into the future, although the estimated coefficient on *lnMBAf* rises somewhat above 1 in some years when *Z* covariates are included.

B. Effect of Benefit Size on Work

Consistent with economic theory, benefit size has a negative effect on the probability that married retirees were recorded as "currently working" when the survey was performed (around the end of 1982). The results for retired husbands, presented in Table 7a, suggest a 10% increase in MBA reduces the probability of work by 3-4 percentage points. The results for retired wives, presented in Table 7b, suggest a 10% increase in MBA reduces the probability of work by 2-3 percentage points. In both cases, the estimated effects are modestly stronger when the *X* covariates were included. Estimates are robust to inclusion of health covariates and exclusion of subjects who had started benefits prior to 1980.

Table 8a demonstrates that the effect of benefit size on husbands' work is primarily driven by increases in part-time rather than full-time work. Estimates suggest a 10% increase in MBA decreases the probability a retired husband was working at least 15 hours a week by 5 percentage points. In contrast, the estimated effect on the probability a husband worked at least 35 hours is modest and insignificant. A similar pattern emerges for retired wives (see Table 8b). A 10% increase in MBA decreases the probability a retired wife was working at least 15 hours a week by 3 percentage points, while the estimated effect on full-time work is negligible.

Tables 9a and 9b repeat the probability of work analysis for the years 1983-1991. Reported work status is not available by year, so positive recorded covered earnings (in the SSA administrative files) are used to proxy for work over these years. Oddly, the negative estimated effect of *lnMBAf* on the probability a husband was working in 1983 is insignificant and somewhat smaller than the "currently working" estimate (see Table 9a). In 1984 and 1985, the work effect is somewhat larger and significant. Over these years (which are generally about 3-5 years after the husband retired), a 10% increase in MBA decreases the probability of work by 5-6 percentage points. The effect appears to erode over 1986 and 1987, and is basically zero from 1988 forward. The results for wives (Table 9b) are somewhat similar, however the estimated effect of benefit size is small and insignificant in both 1983 and 1984. In 1986, a significant negative effect is estimated of similar magnitude to the "currently working" estimates. From there, the effect appears to erode.

C. Effect of Benefit Size on Earnings and Income

The effect of SS benefit size on retirees' work suggests that reductions in benefits are potentially offset by increases in post-retirement earnings, at least for some segment of the retirement population. Changes in benefit size are also potentially offset by changes in other income sources, particularly pension benefits and contributions from family members outside the household. Additional analyses were performed to determine whether SS benefit size had a measurable impact on various sources of income. These results are generally too imprecise to draw strong conclusions, however some tentative implications are suggested.

Table 10 presents IV estimates of the effect of benefit size on the level of income from various income sources, with predicted *MBAf* used to instrument for recorded household *MBA*. Evidence of discernible offsetting behavior is limited by the imprecision of these estimates. As expected, benefit size has a positive, statistically significant effect on received SS income, with SS income increasing about 70 cents for each additional dollar of benefit. Pension income appears to decline about 67 cents for each additional dollar of benefits, the only other statistically significant result. Surprisingly, there is no evidence that benefit size decreases the level of earnings of either spouse. In both cases, the estimates are insignificant and wrong-signed given the estimated effect on probability of work. Overall, the estimated effect of benefit size on total income varies, from 0.51 in the model including the *X* covariates to 0.10 in the model excluding them, though in both cases the estimates are highly insignificant.

Log income models suggest that benefit size does in fact have a substantial impact on total income. As demonstrated in Table 11, a 10% increase in benefit size increases total income by 5.4-5.8%, with the estimates statistically significant across all log models. Some evidence of an offset in non-SS sources of income is again evident, though the estimates are insignificant. When log non-SS income is censored from below at zero, the estimated effect of log benefit size ranges from -0.12 to -0.17, suggesting only modest offsets.

Table 12a presents estimates for the effect of *lnMBAf* on the earnings of retired husbands reported over the last quarter. Notably, 13% of the husbands not currently working report positive earnings in the last quarter, while 5% of those currently working do not. Though insignificant, estimates are consistent with expectations, suggesting a negative effect of *lnMBAf* on the probability of low earnings, but negligible effect on the probability of high earnings. Conditioning on husbands with positive earnings, a 10% increase in benefit size appears to decrease the husbands' earnings 7-10%. Applying the "smearing estimator" developed by Duan (1983) and assuming independent error terms across the probability of positive earnings and the log earnings conditional on positive earnings models, the Model 2 results suggest a 10% increase in MBA ($94 dollars on average) decreases average husbands' earnings by $34. To the extent that the error terms are positively correlated, this is likely an over-estimate of the aggregate offset in husbands' earnings.

Table 12b repeats this analysis for wives, producing somewhat surprising results. Again, the effect of benefit size on positive wives' earnings is somewhat smaller than the estimated effect on the probability of work. A significant negative effect on the probability quarterly earnings exceeded $500 is estimated when *X* covariates are included. However, a *positive* significant effect is estimated on the probability of earnings exceeded $1755. I offer no explanation for this unanticipated result.

Similar analyses were performed on the effect of *lnMBAf* on asset, pension and other income (see Appendix Tables A2-A4). Evidence from the pension models provide weak evidence of benefit offsets in the model including *X* covariates. Benefit size had a statistically significant effect on the probability of reporting positive other income, but no effect on the probability of reporting other income in excess of $300. This suggests the assistance retirees receive from outside the household is affected by benefit size, but that this assistance does not amount to much.

D. Specification Tests

Specification tests were performed to verify the plausibility of the identification strategy used in this paper. The intuition behind these tests is straightforward: if *lnMBAf* is correlated with the *unobserved* determinants of work conditional on the *Z* covariates, we would expect it to be correlated with the *observed* determinants of work as well. The specification tests were performed in two steps. First, logit regression models of the husbands' probability of work were estimated conditioning on the *Z* and *X* covariates, $\text{Prob}[\text{work}_i] = \Lambda(\beta X_i + \gamma Z_i)$, from which a linear prediction of $\beta X_i + \gamma Z_i$ for each husband. Likelihood-ratio tests demonstrated that the *X* covariates were strong predictors of husbands' work ($p<.0001$). The linear predictions were then the dependent variable in an OLS regression conditioning on *lnMBAf* and the *Z* covariates. As seen in column 1 of Table 13a, *lnMBAf* is weakly and insignificantly correlated with the observed determinants of husbands' work conditional on the *Z* covariates. The positive correlation grows modestly when covariates for reported health are included in the *X* vector, but the correlations are highly insignificant across all specifications.

Table 13b repeats this analysis for wives in our sample. Again, the *X* covariates were found to be strong predictors of wives' work ($p<.0001$). *LnMBAf* displays a small, insignificant negative correlation with the observed determinants of wives' work when the reported health covariates are excluded. The estimated correlation is somewhat sensitive to inclusion of different health covariates in the *X* vector, but the correlation remains highly insignificant across specifications. Together, these results demonstrate that, conditional on the benefit formula inputs, *lnMBAf* is uncorrelated with observed predictors of work.

VI. Conclusions

Heavy reliance on Social Security leaves the elderly susceptible to financial hardship when benefits are reduced. In 1997, the median elderly person (age $\geq$ 65) received more than half of their income from Social Security, and 15% depended on SS as their sole source of income (see Figure 1). Even at current benefit levels, the elderly suffer high rates of financial hardship. Over 10% of the elderly population (age $\geq$ 65 years) has incomes below the poverty threshold and almost 17% has incomes less than 125% of the threshold (see Table 1). Porter, Larin and Primus (1999) estimate that SS income reduced the elderly poverty rate by some 75% in 1997 (see Figure 2), although their estimate assumes SS income is not offset by other income sources. Nonetheless, the link between SS and the financial well-being of the elderly is clear. Unless workers respond by (1) delaying retirement, (2) increasing pre-retirement savings or (3) increasing earnings post-retirement, retirees will face a higher level of financial hardship as the normal retirement age increases.

An enormous economic literature exists that attempts to evaluate the effect of Social Security on retirement behavior. To date, this literature has focused primarily on two issues: how SS affects the timing of retirement and the effect of the SS earnings test on beneficiaries' labor supply. In contrast, minimal research exists on the pure income effect of SS benefit size on the decision to work post-retirement.[24] This is a rather glaring hole in the literature given changes in the Social Security system that will reduce benefits more than 12% over the next 20 years for those retiring between the

24 In their chapter in the *Handbook of Labor Economics*, Lumsdaine and Mitchell (1999) make no mention of studies in this area.

ages 62 and 65. The results presented here help fill this gap in the literature, establishing the casual link between benefit size and the decision to work post-retirement.

Consistent with the standard labor supply model, I find statistically significant evidence that the probability of working among married, jointly-retired social security recipients decreases with increases in SS benefit size, though the effects are rather modest. A 10% increase in benefit size decreases the probability a husband was currently working by 3-4 percentage points (from a mean of 25.5%) and decreases the probability a wife was currently working by 2-3 percentage points (from a mean of 12.8%). For both sexes, the effect appears to disappear in the later years of retirement. While some retirees might offset lower benefits by increasing earnings, we should not expect earnings to offset lower benefits for older retirees.

The work effect estimates are generally consistent with estimates presented by other researchers. Snyder and Evans (2001) found that elderly men born immediately after the benefits notch received about $57 less OASI income on average than those born immediately preceding the notch, and the probability of work in the post-notch group was 2.9 percentage points lower. My results would have suggested a smaller reduction in work (about 2 percentage points), though the difference is possibly driven by different definitions of work.[25] Friedberg (1999) finds a significant, negative income effect on the work hours of working retired men, though her analysis does not specifically address the decision to work.

Estimates of the effect of benefit size on income from various sources are too imprecise to draw strong conclusions. Nonetheless, benefit size appears to have a substantial and significant effect on log total income. The results suggest that changes in benefit size are offset to some degree by reductions in husbands' earnings and pension income, though estimates are imprecise and vary by specification. Oddly, I found no evidence that higher benefits reduce wives' earnings despite the negative effect on wives' probability of work.

25 Snyder and Evans (2002) define work as having worked in the past year rather than currently working, which could lead to larger work effect estimates.

Perhaps just as important as the empirical findings, this paper demonstrates that non-linearities in the SS benefits formula can be a useful source of exogenous variation in benefit size. Specification tests demonstrate that, conditional on benefit formula inputs, benefit size is uncorrelated with observed determinants of work. By itself, this is an important result given the general difficulty in finding exogenous determinants of income. Hopefully, this empirical approach can be replicated by other researchers interested in studying the relationship between income and any number of post-retirement outcomes.

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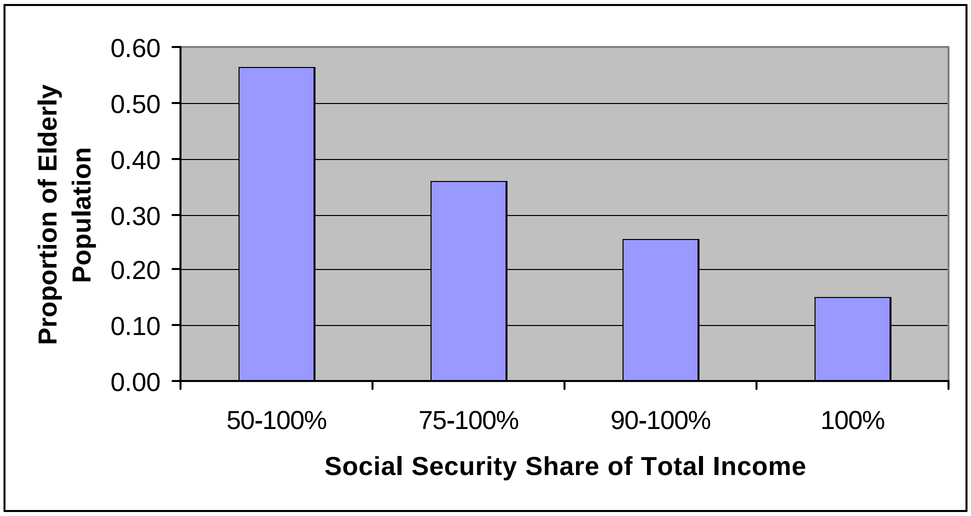
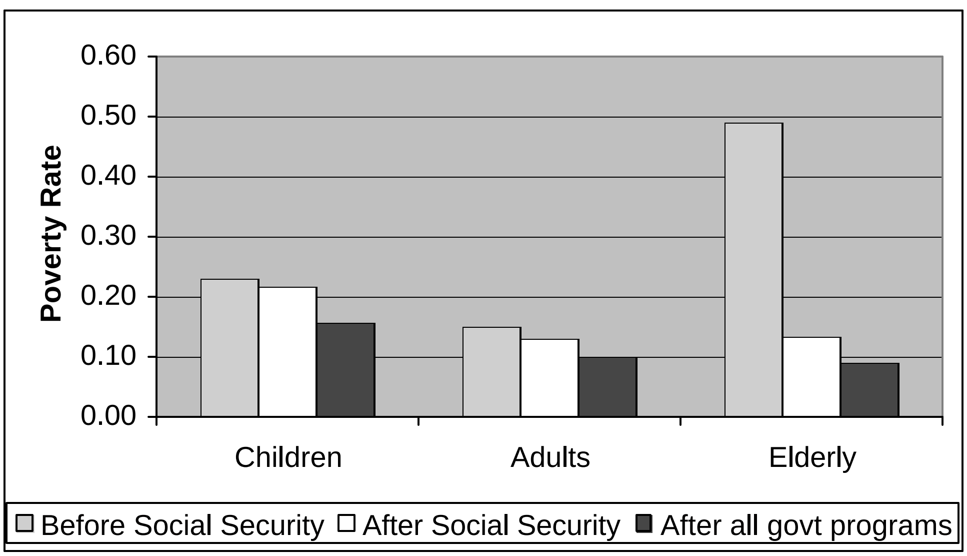
Figure 1
Social Security Share of Elderly Income



Date Source: Porter, Larin and Primus (1999).

Figure 2
Estimated Poverty Rates net Social Security Income



Date Source: Porter, Larin and Primus (1999).

Figure 3
Effect of Changes in $LnPIA_i$ on LnMBA

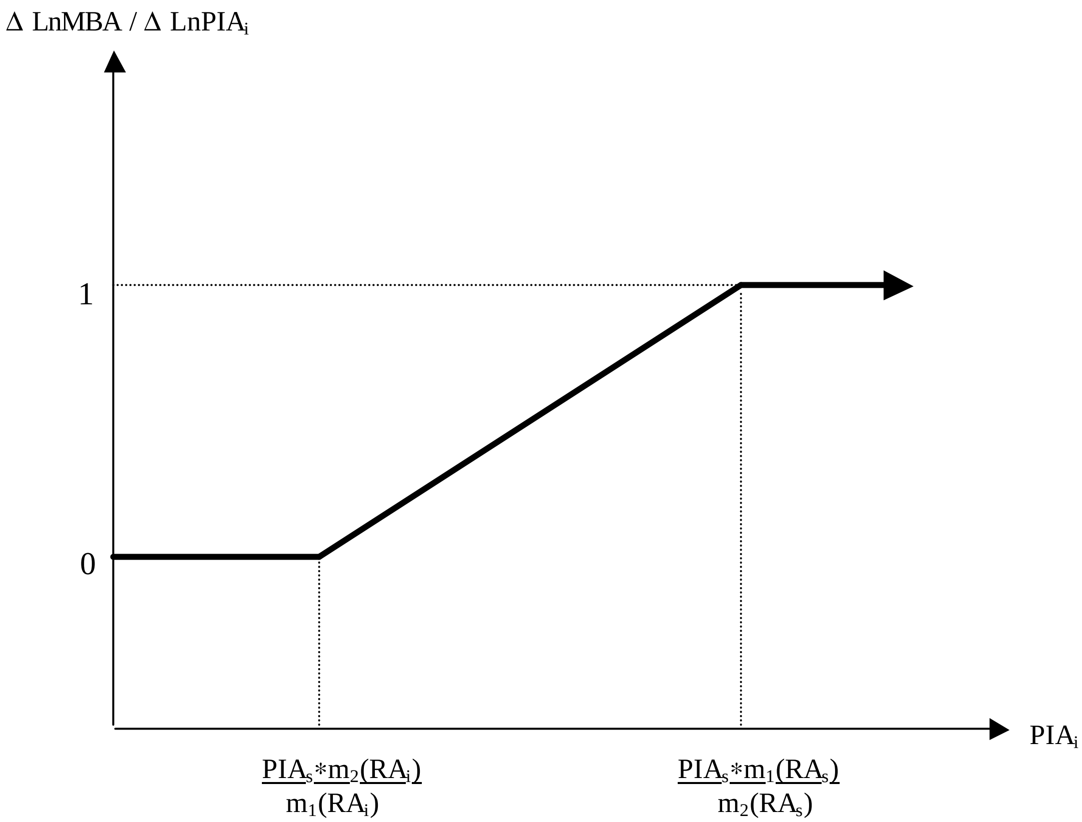


Figure 4
Budget Constraint under OASI Earnings Test

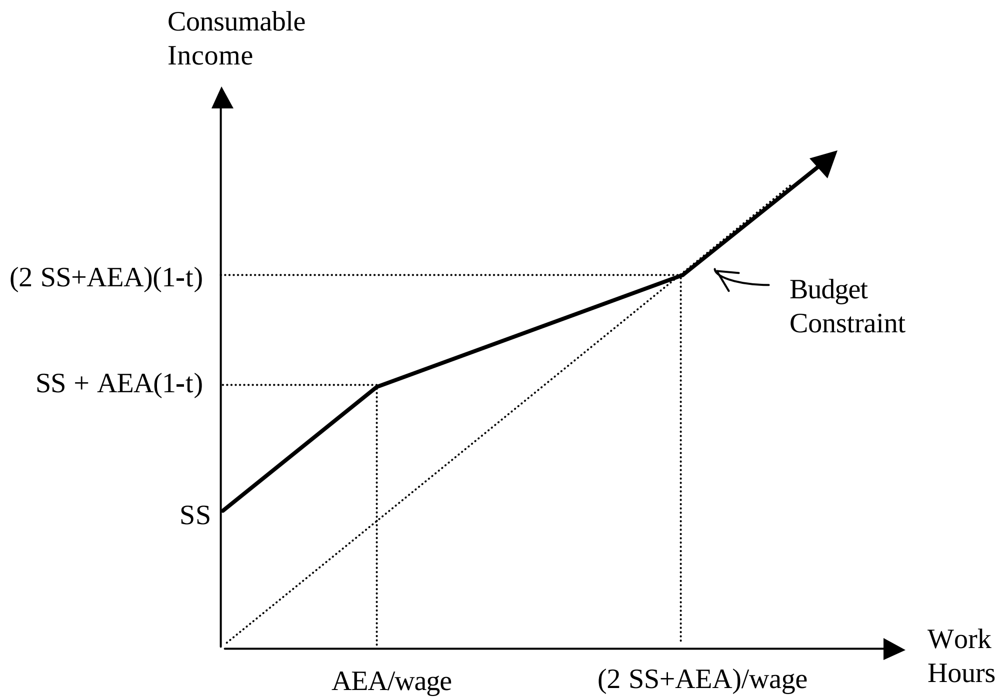


Figure 5
Effect of Change in SS Benefit on Budget Constraint

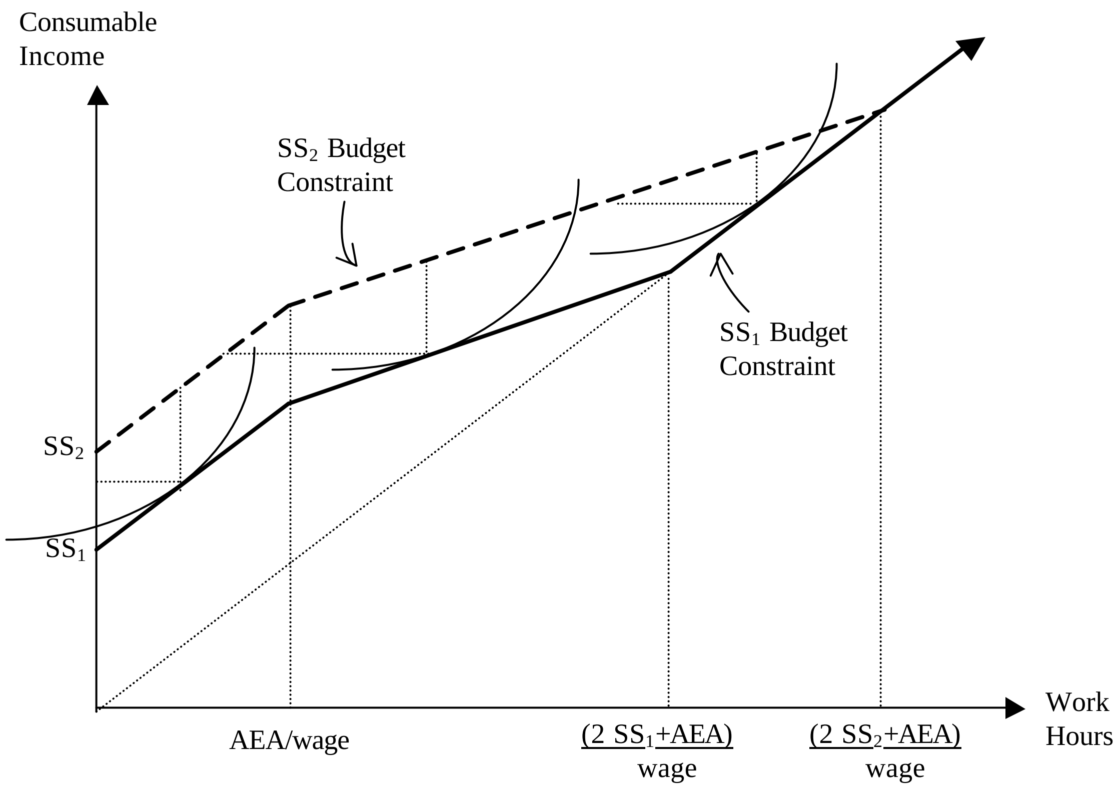


Figure 6
Decision to Work with Fixed-Hours Employment Option

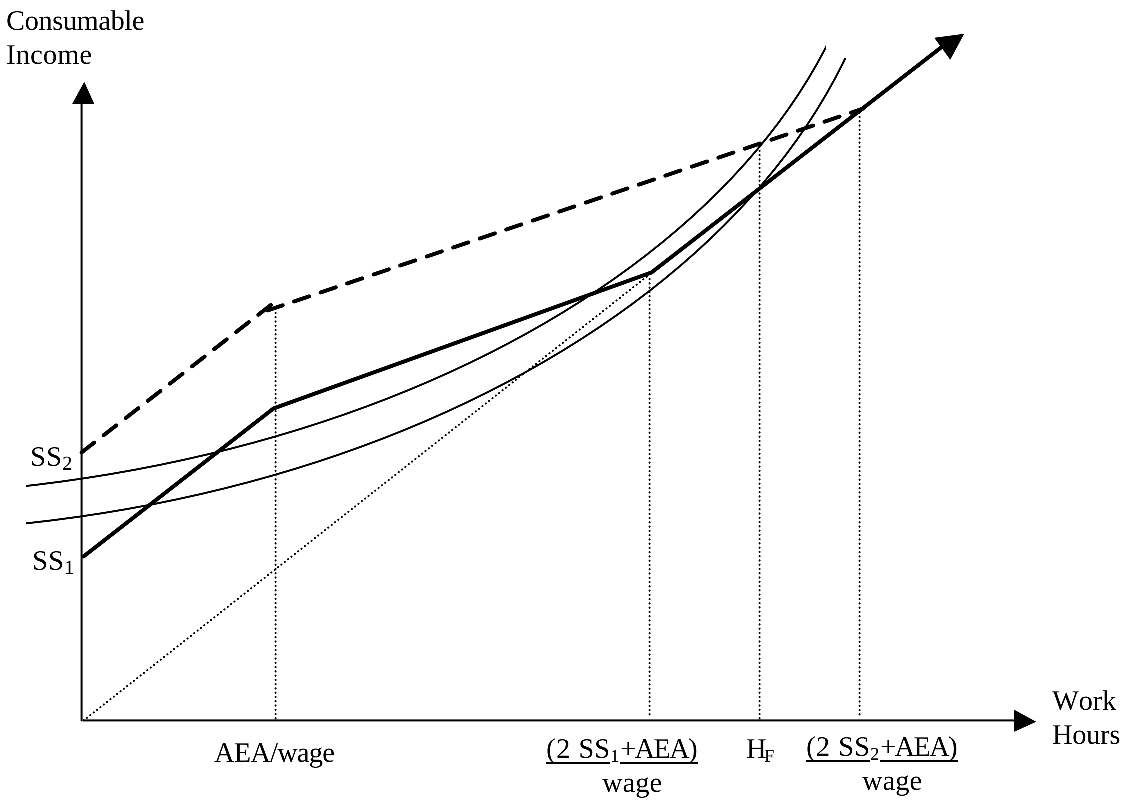


Figure 7
Predicted versus Recorded MBA

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PostScript printer, but not to
other types of printers.

Notes: N=3059, all couples where spouse of respondent started benefits by 1982.
+ represents 248 couples that were dropped due to large discrepancy between the recorded and predicted PIAs.
° represents 2811 couples in the "both retired" dataset (no substantial PIA discrepancy).

Table 1
Ratio of Family Income to Poverty Threshold by Age (2001)

Age (years)	Total (millions)	Percent < 0.50	Percent < 1.00	Percent < 1.25
≤ 18	72.0	7.1	16.3	21.9
18-24	27.3	7.7	16.3	21.3
25-34	38.7	4.9	11.0	15.1
35-44	44.3	3.6	8.6	11.7
45-54	39.5	2.8	7.1	9.7
55-59	14.7	3.4	8.7	11.5
60-64	11.2	3.5	10.3	14.2
≥ 65	33.8	2.2	10.1	16.6

Source: U.S. Census Bureau, Current Population Survey, 2002 Annual Demographic Supplement.

Table 2
Sample Selection Criteria

Selection Criteria	Number Dropped	Resulting Sample Size
Respondent married w/ completed spousal questionnaire	---	7638
Husband born $\in$ [1910, 1919] Wife born $\in$ [1912, 1919]	3165	4473
No public assistance other than worker/spousal OASI benefit[a]	412	4061
No federal/military pension or veteran's benefit	542	3519
No child under 18	30	3489
Problem w/ PIA Calculation[b]	293	3196
Spouse "retired" before 1982[c]	385	2811

[a] Dropped couples receiving DI, SSI, state welfare, worker's comp or unemployment benefits.
[b] Dropped couples if eligible worker had recorded PIA that deviated by more than 10% from PIA predicted by the benefit formula. In addition, six other couples were dropped: three where the wife appeared to be earnings spousal benefits on a prior spouse's record; three where wife's and husband's covered earnings records were identical, yet the wife was receiving a spousal benefit.
[c] Throughout paper, the term "retired" is used to describe individuals who have initiated OASI benefit receipt.

Table 3
Summary Statistics

	Sample Means (s.d.) or Percent		
Variable	*Both Retired (N=2811)*	*Wife not Ret'd (N=176)*	*Husband not Ret'd (N=209)*
Female[a]	55.5%	0%	100%
Black[a]	4.5%	6.8%	4.8%
Hispanic/non-black[a]	2.0%	1.7%	2.4%
H Age[b]	67.4 (2.2)	67.0 (1.7)	65.7 (2.1)
W age[b]	65.6 (1.8)	64.2 (1.2)	65.9 (1.7)
H education (yrs)[c]	11.2 (3.0)	11.6 (3.1)	12.8 (3.1)
H educ ≤ 5 yrs	4.3%	5.7%	2.9%
W education (yrs)[c]	11.4 (2.6)	11.9 (2.6)	12.4 (2.7)
W educ ≤ 5 yrs	2.6%	3.4%	1.4%
Years Married	40.3 (8.5)	38.7 (9.2)	37.5 (9.6)
H Pension[d]	65.1%	65.3%	61.2%
W Pension[d]	29.2%	47.7%	40.2%
H professional[e]	22.2%	21.6%	41.6%
H self-employed[e]	24.4%	23.3%	26.2%
W professional[e]	10.5%	25.6%	14.8%
W self-employed[e]	5.3%	6.3%	11.5%
Asset Wealth($)[f]	114,428 (114,276)	136,757 (130,689)	134,627 (132,375)
Assets Wealth > $500k	3.1%	5.1%	5.7%
H Ret-age	64.5 (1.8)	65.0 (1.6)	--
H Ret-age ≥ 65	30.7%	39.7%	--
W Ret-age	63.4 (1.5)	--	63.9 (1.7)
W Ret-age ≥ 65	12.3%	--	20.8%

Notes: Indicator variables for (H/W) previously widowed, (H/W) previously married but not widowed, adult child present in household, other adult present in household are also included in the *X* covariate vector.
[a] Sex and race/ethnicity variables refer to respondent.
[b] Age calculated in months as of 12/82.
[c] Education years truncated from below at 5 years.
[d] Pension variables based on surveys responses to having contributed to a pension plan.
[e] "Professional" and "self-employed" refers to description of longest job.
[f] Asset wealth truncated from above at $500,000.

Table 4
SS Benefits and Income

	Sample Means (s.d.) or Percent		
Variable	*Both Retired (N=2811)*	*Wife not Retired (N=176)*	*Husband not Retired (N=209)*
Total MBA[a]	942 (238)	--	--
Total MBAf[a]	942 (238)	--	--
Social Security Income[b]	858 (266)	689 (305)	488 (350)
Asset Income	387 (841)	435 (667)	467 (1303)
Pension Income	265 (424)	248 (459)	153 (330)
H Currently Working[c]	25.5%	43.2%	74.2%
H Earned Income	147 (426)	248 (490)	1195 (1508)
W Currently Working[c]	12.8%	60.2%	29.2%
W Earned Income	69 (330)	622 (741)	213 (577)
Other Income	72 (541)	191 (2017)	50 (304)
Total Income	1798 (1310)	2433 (2473)	2567 (2355)

Notes: Income/benefit variables reported in 1982 dollars. Income by source was reported for the quarter preceding survey date, converted to monthly values.
[a] Total MBA refers to total of couple's total monthly benefit amount as recorded for December 1982. Total MBAf refers to couple's total monthly benefit in 1982 as predicted by the benefits formula.
[b] Actual social security income can vary from recorded MBA as result of earnings offset.
[c] Currently working at time of survey.

Table 5
***LnMBA* Prediction Models**
OLS Estimates

	Model 0	Model 1	Model 2
LnMBAf	1.00 (.00)	0.96 (.01)	0.97 (.01)
Z covariates included		X	X
X covariates included			X
R-squared	.991	.994	.994

Notes: N=2811 (both-retired sample). Robust standard errors shown in parentheses.

Table 6
***LnMBA* Prediction Models by Year**
OLS Estimates

	Dependent Variable								
	LnMBA83	*LnMBA84*	*LnMBA85*	*LnMBA86*	*LnMBA87*	*LnMBA88*	*LnMBA89*	*LnMBA90*	*LnMBA91*
Model 0	1.01	1.00	1.01	1.02	1.01	1.01	1.00	1.00	1.00
	(.00)	(.00)	(.01)	(.01)	(.00)	(.00)	(.01)	(.01)	(.01)
Model 1	1.02	1.03	1.09	1.09	1.03	1.04	1.08	1.06	1.06
	(.01)	(.02)	(.04)	(.04)	(.03)	(.03)	(.05)	(.05)	(.05)
Model 2	1.01	1.02	1.09	1.08	1.03	1.03	1.07	1.05	1.05
	(.02)	(.02)	(.04)	(.04)	(.03)	(.03)	(.05)	(.05)	(.05)
N	2711	2622	2493	2365	2238	2142	2021	1881	1755

Notes: Estimated coefficients and robust standard errors shown for *LnMBAf*. Includes couples both retired by 1982 and both surviving through year of interest.

Table7a
Probability Husband Currently Working
Logit Estimates

	Model 1	Model 2	Model 2	Model 2	Model 2	Model 2	Model 2
LnMBAf	-2.15* (1.18) [-.03]	-2.63** (1.23) [-.04]	-2.60** (1.23) [-.04]	-3.03* (1.59) [-.05]	-2.97* (1.61) [-.04]	-3.05* (1.59) [-.05]	-2.86* (1.62) [-.04]
Excludes H if received SS before 1980				X	X	X	X
Work Limit covariates included			X		X		
Previous HA/Stroke covariates included						X	
Health Condition covariates included							X
Pseudo R-squared	.127	.181	.193	.206	.215	.207	.211
Mean Dep. Variable	.255	.255	.255	.277	.277	.277	.277
N	2811	2811	2811	1975	1975	1975	1975

Notes: *LnMBAf* coefficient, robust standard error (in parentheses) and average marginal effect (in brackets) shown for all models. Work limit covariates include indicator (dummy) variables for condition limiting work at home, work for pay, both or neither. Previous HA/stroke covariates include indicator variables for report of heart attack or stroke (reported yes, reported no, or missing). Major health condition covariates include indicator variables for number of major conditions reported (zero, 1, 2, ≥3, or missing). Health variables included for both spouses. (*p<0.10, **p<0.05)

Table 7b
Probability Wife Currently Working
Logit Estimates

	Model 1	Model 2	Model 2	Model 2	Model 2	Model 2	Model 2
LnMBAf	-2.71* (1.42) [-.02]	-3.22** (1.49) [-.03]	-3.35** (1.53) [-.03]	-3.24* (1.76) [-.02]	-3.23* (1.76) [-.02]	-3.19* (1.70) [-.02]	-3.53** (1.69) [-.03]
Excludes W if received SS before 1980				X	X	X	X
Work Limit covariates included			X		X		
Previous HA/Stroke covariates included						X	
Health Condition covariates included							X
Pseudo R-squared	.261	.310	.324	.342	.354	.344	.347
Mean Dep. Variable	.128	.128	.128	.129	.129	.129	.129
N	2811	2811	2811	2459	2459	2459	2459

Notes: *LnMBAf* coefficient, robust standard error (in parentheses) and average marginal effect (in brackets) shown for all models. Work limit covariates include indicator (dummy) variables for condition limiting work at home, work for pay, both or neither. Previous HA/stroke covariates include indicator variables for report of heart attack or stroke (reported yes, reported no, or missing). Major health condition covariates include indicator variables for number of major conditions reported (zero, 1, 2, ≥3, or missing). Health variables included for both spouses. (*p<0.10, **p<0.05)

Table 8a
Husband Hours of Work per Week
Logit Estimates

	Dependent Variable				
	Hours>0	Hours≥15	Hours≥25	Hours≥35	Hours≥45
Model 1	-2.15*	-3.58**	-2.90*	-2.19	-3.82
	(1.18)	(1.31)	(1.61)	(1.71)	(3.11)
	[-.03]	[-.05]	[-.02]	[-.01]	[-.01]
Model 2	-2.63**	-4.14**	-3.23**	-2.54	-4.67
	(1.23)	(1.35)	(1.59)	(1.76)	(4.60)
	[-.04]	[-.05]	[-.03]	[-.02]	[-.01]
Mean Dep. Var.	.255	.189	.110	.081	.029

Notes: N=2811. *LnMBAf* coefficient, robust standard error (in parentheses) and average marginal effect (in brackets) shown for each model. (*p<0.10, **p<0.05)

Table 8b
Wife Hours of Work per Week
Logit Estimates

	Dependent Variable			
	Hours>0	Hours≥15	Hours≥25	Hours≥35
Model 1	-2.71*	-4.15**	-2.53	-1.08
	(1.42)	(1.57)	(2.46)	(3.64)
	[-.02]	[-.03]	[-.01]	[-.00]
Model 2	-3.22**	-4.35**	--	--
	(1.49)	(1.72)		
	[-.03]	[-.03]		
Mean Dep. Var.	.128	.095	.048	.032

Notes: N=2811. *LnMBAf* coefficients, robust standard errors (in parentheses) and average marginal effects (in brackets) shown for each model. Results omitted when covariates exactly predict outcome for subgroup of individuals.
*p<0.10, **p<0.05

Table 9a
Husband Work over Time
Logit Estimates

	Dependent Variable								
	CE83>0	*CE84>0*	*CE85>0*	*CE86>0*	*CE87>0*	*CE88>0*	*CE89>0*	*CE90>0*	*CE91>0*
Model 1	-0.94	-2.76**	-2.76**	-1.14	-.044	0.81	-1.42	-0.14	1.70
	(1.16)	(1.22)	(1.34)	(1.40)	(1.52)	(1.61)	(1.78)	(1.92)	(2.29)
	[-.02]	[-.05]	[-.05]	[-.02]	[-.01]	[.01]	[-.02]	[-.00]	[.02]
Model 2	-1.03	-3.36**	-3.14**	-1.87	-0.93	0.35	-2.03	-0.67	1.73
	(1.22)	(1.26)	(1.38)	(1.46)	(1.55)	(1.67)	(1.82)	(1.99)	(2.38)
	[-.02]	[-.06]	[-.05]	[-.03]	[-.01]	[.01]	[-.02]	[-.01]	[.02]
Mean Dep. Variable	.296	.274	.250	.225	.205	.200	.171	.158	.139
N	2742	2685	2583	2492	2406	2313	2217	2121	2018

Notes: Estimated *lnMBAf* coefficient, robust standard error (in parentheses) and average marginal effect (in brackets) shown. Husband assumed to be working if covered earnings are recorded for the given year. Husbands who die in or before given year are excluded.
*p<0.10, **p<0.05

Table 9b
Wife Work over Time
Logit Estimates

	Dependent Variable								
	CE83>0	*CE84>0*	*CE85>0*	*CE86>0*	*CE87>0*	*CE88>0*	*CE89>0*	*CE90>0*	*CE91>0*
Model 1	-1.52 (1.50) [-.01]	-1.68 (1.55) [-.01]	-2.31 (1.53) [-.02]	-3.90** (1.53) [-.03]	-2.53 (1.67) [-.02]	-0.34 (1.75) [-.00]	1.36 (2.25) [.01]	--	--
Model 2	-1.22 (1.60) [-.01]	-1.33 (1.65) [-.01]	-2.10 (1.59) [-.02]	-4.67** (1.69) [-.03]	-3.07* (1.75) [-.02]	-0.93 (1.88) [-.01]	--	--	--
Mean Dep. Variable	.136	.114	.105	.092	.085	.077	.063	--	--
N	2780	2746	2709	2662	2612	2586	2540	--	--

Notes: Estimated *lnMBAf* coefficient, robust standard error (in parentheses) and average marginal effect (in brackets) shown. Wife assumed to be working if covered earnings are recorded for the given year. Wives who die in or before given year are excluded. Results omitted when covariates exactly predict outcome for subgroup of individuals.
*p<0.10, **p<0.05

Table 10
Effect of Benefit Size on Income Levels
IV Estimates

	Dependent Variable							
	Total Income	SS Income	Non-SS Income	H Earned Income	W Earned Income	Pension Income	Asset Income	Other Income
Model 1	0.10	0.66**	-0.56	0.28	0.10	-0.77**	-0.08	-0.08
	(.99)	(.16)	(1.00)	(.36)	(.25)	(.37)	(.56)	(.53)
Model 2	0.51	0.74**	-0.23	0.25	0.09	-0.57*	-0.01	.00
	(.87)	(.16)	(.89)	(.41)	(.24)	(.31)	(.45)	(.56)

Notes: N=2811. Estimated coefficient for total household *MBA* (instrumented with *MBAf*) and robust standard errors reported.
*p<0.10, **p<0.05

Table 11
Effect of Benefit Size on Log Income
IV Estimates

	Dependent Variable					
	Omits observations if income £ 0			*Log income censored from below at 0*		
	Total Income	SS Income	Non-SS Income	Total Income	SS Income	Non-SS Income
Model 1	0.55**	0.87**	-0.45	0.58**	0.92**	-0.12
	(.25)	(.13)	(.70)	(.25)	(.27)	(.94)
Model 2	0.54**	0.91**	-0.61	0.58**	0.95**	-0.17
	(.20)	(.14)	(.58)	(.21)	(.28)	(.81)
N	2809	2779	2701	2811	2811	2811

Notes: Estimated *lnMBA* coefficient (instrumented with *lnMBAf*) and robust standard errors reported.
*p<0.10, **p<0.05

Table 12a
Effect of Benefit Size on Husbands' Earnings
Logit/OLS Estimates

	Dependent Variable				
	Earnings>0	Earnings≥675	Earnings≥1200	Earnings≥1800	Ln(Earnings) | Earnings>0
Model 1	-1.21	-1.45	-1.10	1.10	-0.71
	(1.18)	(1.38)	(1.56)	(2.08)	(.92)
	[-.02]	[-.02]	[-.01]	[.01]	
Model 2	-1.83	-2.23	-2.01	0.23	-1.00
	(1.24)	(1.49)	(1.59)	(2.25)	(.98)
	[-.03]	[-.03]	[-.02]	[.00]	
Mean Dep Var	0.254	0.191	0.133	0.065	5.91
N	2811	2811	2811	2811	714

Notes: *LnMBAf* coefficient, robust standard error (in parentheses) and average marginal effect (in brackets) shown for logit models. Threshold values correspond to quartiles in the earnings distribution for husbands with positive earnings. *LnMBA* coefficient and robust standard errors reported for conditional log earnings OLS model.
*p<0.10, **p<0.05

Table 12b
Effect of Benefit Size on Wives' Earnings
Logit/OLS Estimates

	Dependent Variable				
	Earnings>0	Earnings≥500	Earnings≥1015	Earnings≥1755	Ln(Earnings) | Earnings>0
Model 1	-1.36	-2.42	0.09	5.74**	0.76
	(1.45)	(1.49)	(1.97)	(2.83)	(1.47)
	[-.01]	[-.02]	[.00]	[.02]	
Model 2	-1.51	-2.60*	0.64	5.38*	0.81
	(1.52)	(1.54)	(2.07)	(2.89)	(1.60)
	[-.01]	[-.02]	[.00]	[.01]	
Mean Dep Var	0.141	0.106	0.071	0.036	5.70
N	2811	2811	2811	2811	397

Notes: *LnMBAf* coefficient, robust standard error (in parentheses) and average marginal effect (in brackets) shown for logit models. Threshold values correspond to quartiles in the earnings distribution for wives with positive earnings. *LnMBA* coefficient and robust standard errors reported for conditional log earnings OLS model.
*p<0.10, **p<0.05

Table 13a
Specification Tests
Observed Determinants of Husbands' Work
OLS Estimates

	(1)	(2)	(3)	(4)
LnMBAf	0.08 (.28)	0.17 (.33)	0.11 (.29)	0.11 (.30)
X vector includes covariates for condition limiting work		X		
X vector includes indicators of prior heart attack/stroke			X	
X vector includes covariates for count of major health conditions				X
R-squared	.749	.697	.745	.734

Notes: N=2811. Dependent variable (Y) is predicted value of ßX + ?Z from logit estimation of probability husband currently working. OLS coefficient and standard errors shown for *LnMBAf* in regression model Y = ? *Z* + ? *LnMBAf* + e. Variables included in vector *X* vary as indicated in table. Work limit covariates include indicator (dummy) variables for condition limiting work at home, work for pay, both or neither. Previous HA/stroke covariates include indicator variables for report of heart attack or stroke (reported yes, reported no, or missing). Major health condition covariates include indicator variables for number of major conditions reported (zero, 1, 2, ≥3, or missing). Health variables included for both spouses.
*p<0.10, **p<0.05

Table 13b
Specification Tests
Observed Determinants of Wives' Work
OLS Estimates

	(1)	(2)	(3)	(4)
LnMBAf	-0.28 (.31)	-0.05 (.38)	-0.32 (.32)	0.20 (.47)
X vector includes covariates for condition limiting work		X		
X vector includes indicators of prior heart attack/stroke			X	
X vector includes covariates for count of major health conditions				X
R-squared	.863	.816	.858	.746

Notes: N=2811. Dependent variable (Y) is predicted value of ßX + ?Z from logit estimation of probability wife currently working. OLS coefficient and standard errors shown for *LnMBAf* in regression model Y = ? *Z* + ? *LnMBAf* + e. Variables included in vector *X* vary as indicated in table. Work limit covariates include indicator (dummy) variables for condition limiting work at home, work for pay, both or neither. Previous HA/stroke covariates include indicator variables for report of heart attack or stroke (reported yes, reported no, or missing). Major health condition covariates include indicator variables for number of major conditions reported (zero, 1, 2, ≥3, or missing). Health variables included for both spouses.
*p<0.10, **p<0.05

Appendix Table A1
Maximum Covered Earnings for years 1951-1981

Year	Mean Nominal Earnings ($)	Maximum Covered Earnings ($)	Max CE as % of Mean Nom Earnings
1951	2799.16	3600	1.29
1952	2973.32	3600	1.21
1953	3139.44	3600	1.15
1954	3155.64	3600	1.14
1955	3301.44	4200	1.27
1956	3532.36	4200	1.19
1957	3641.72	4200	1.15
1958	3673.8	4200	1.14
1959	3855.8	4800	1.24
1960	4007.12	4800	1.20
1961	4086.76	4800	1.17
1962	4291.4	4800	1.12
1963	4396.64	4800	1.09
1964	4576.32	4800	1.05
1965	4658.72	4800	1.03
1966	4938.36	6600	1.34
1967	5213.44	6600	1.27
1968	5571.76	7800	1.40
1969	5893.76	7800	1.32
1970	6186.24	7800	1.26
1971	6497.08	7800	1.20
1972	7133.8	9000	1.26
1973	7580.16	10800	1.42
1974	8030.76	13200	1.64
1975	8630.92	14100	1.63
1976	9226.48	15300	1.66
1977	9779.44	16500	1.69
1978	10556.03	17700	1.68
1979	11479.46	22900	1.99
1980	12513.46	25900	2.07
1981	13773.1	29700	2.16

Appendix Table A2
Asset Income in Last Quarter
Logit Estimates

	Dependent Variable			
	Income>0	Income≥150	Income≥600	Income≥1500
Model 1	-0.76	-0.73	-0.77	0.60
	(1.46)	(1.05)	(1.01)	(1.23)
	[-.01]	[-.01]	[-.02]	[.01]
Model 2	0.63	-0.59	-2.01	-1.51
	(1.69)	(1.30)	(1.21)	(1.58)
	[.00]	[-.01]	[-.03]	[-.01]
Mean Dep. Variable	0.878	0.660	0.439	0.220

Notes: N=2811. *LnMBAf* coefficient, robust standard error (in parentheses) and average marginal effect (in brackets) shown for all models. Threshold values correspond to quartiles in the asset income distribution for couples with positive asset income.

Appendix Table A3
Pension Income in Last Quarter
Logit Estimates

	Dependent Variable			
	Income>0	Income≥595	Income≥1100	Income≥1900
Model 1	-0.40	-0.63	-1.64	-0.79
	(1.13)	(1.14)	(1.26)	(1.52)
	[-.01]	[-.01]	[-.02]	[-.01]
Model 2	-2.52	-2.13	-2.64	-2.35
	(1.76)	(1.69)	(1.60)	(1.84)
	[-.03]	[-.03]	[-.03]	[-.02]
Mean Dep. Variable	0.539	0.404	0.270	0.135

Notes: N=2811. *LnMBAf* coefficient, robust standard error (in parentheses) and average marginal effect (in brackets) shown for all models. Threshold values correspond to quartiles in the pension income distribution for couples with positive pension income.
*p<0.10, **p<0.05

Appendix Table A4
Other Income in Last Quarter
Logit Estimates

	Dependent Variable	
	Income>0	Income≥300
Model 1	-1.79*	-0.45
	(1.02)	(2.49)
	[-.04]	[-.00]
Model 2	-1.76*	-0.80
	(1.04)	(2.71)
	[-.04]	[-.00]
Mean Dep. Variable	0.361	0.072

Notes: N=2811. *LnMBAf* coefficient, robust standard error (in parentheses) and average marginal effect (in brackets) shown for all models. (*p<0.10, **p<0.05)